

REMARKS

By this amendment, applicants have amended claims 14, 16 and 18 to be in independent form by including therein all of the limitations of claims 10, 15 and 1, respectively, from which claims 14, 16 and 18 previously depended. Accordingly, Applicants have canceled claims 1, 10 and 15 without prejudice or disclaimer and have amended claims 6 and 19 to depend from claim 18, have amended claims 12 and 21 to depend from claim 14 and have amended claims 17 and 20 to depend from claim 16.

Since the foregoing amendments merely rewrite claims in independent form (claims 14, 16 and 18), cancel claims (claims 1, 10 and 15) and change the dependency of claims (claims 6, 12, 17 and 19-21), the foregoing amendments do not raise new issues requiring further consideration and/or search. Moreover, the foregoing amendments place the application in condition for allowance for the reasons set forth hereinafter or, at least, in better form for consideration on appeal by materially reducing or simplifying issues on appeal (rendering moot one of the rejections). Accordingly, entry of this amendment under 37 C.F.R. 1.116 is requested.

In view of the foregoing amendments canceling claims 1, 10 and 15 and amending the dependency of claims 6, 12 and 17, the rejection of claims 1, 6, 10, 12, 15 and 17 under 35 U.S.C 103(a) as being unpatentable over Japanese Publication No. JP-2001-243951 (Matsumoto et al.) in view of International Application No. WO 03/044881 (Shiozaki et al.) is moot. In any event, it is submitted the presently claimed invention is patentable over the proposed combination of Matsumoto et al. and Shiozaki et al. for the reasons set forth hereinafter.

Claims 14, 16 and 18-21 stand rejected under 35 U.S.C. 103(a) as being unaptentable over Matsumoto et al. and Shiozaki et al. and further in view of JP-

2001-085006 (Nakano et al.). Applicants traverse this rejection for the reasons set forth in the amendment filed September 2, 2009 and for the following reasons.

The present invention relates to a positive electrode material and to a lithium secondary battery for an automobile comprising the positive electrode material. The positive electrode material includes plural primary particles of planar type flocculated to form a secondary particle. That is, the primary particles are composed of planar crystals having a structure of a composite oxide represented by $\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$ wherein $1 \leq a \leq 1.2$, $0 \leq x \leq 0.65$, $0.33 \leq y < 0.5$, $0 \leq z \leq 0.65$ and $x+y+z=1$, the primary particles being flocculated and linked to form the secondary particle. According to the present invention, the length in which the plural primary particles are linked on the section of the secondary particles equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles. This provides a voidage of the secondary particle of 2.5 to 35%, preferably 2.5 to 10% (see claims 19-21).

The present invention includes a combination of features that the length in which the plural primary particles are linked on the section of the secondary particle is equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles, a voidage of the secondary particle is 2.5 to 35%, the secondary particle is represented as $\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$ and the secondary particle is composed of crystals having layer structure of composite oxide meeting $1 \leq a \leq 1.2$, $0 \leq x \leq 0.65$, $0.35 \leq y < 0.5$, $0 \leq z \leq 0.65$ and $x+y+z=1$.

The present invention is based on the experimental result that when the Ni content of the transition metal of the composite oxide ($\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$), which is the composition of the positive electrode material, is below 50% ($0.35 \leq y < 0.5$), a crystal lattice will hardly vary in volume during charge/discharge, primary particles will hardly be distorted when contact between them is satisfactory (when the length in

which the primary particles are linked on the section of the secondary particle is 10 to 70% of the length of the whole periphery of the plural primary particles), and a cycle characteristic will be excellent.

That is, since the secondary particle of the present invention is represented as $\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$ and is composed of crystals having layer structure of composite oxide meeting $1 \leq a \leq 1.2$, $0 \leq x \leq 0.65$, $0.33 \leq y < 0.5$, $0 \leq z \leq 0.65$ and $x+y+z=1$, it is possible to obtain the secondary particle with a voidage of 2.5 to 35%, and to obtain the length in which the plural primary particles are linked on the section of the secondary particle equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles.

Conversely, in order to obtain a secondary particle with a voidage of 2.5 to 35% and to obtain such a feature that “the length in which the plural primary particles are linked on the section of the secondary particle is equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles,” it is necessary that the secondary particle be represented as $\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$ and be composed of crystals having layer structure of composite oxide meeting $1 \leq a \leq 1.2$, $0 \leq x \leq 0.65$, $0.33 \leq y < 0.5$, $0 \leq z \leq 0.65$ and $x+y+z=1$.

As described above, the present invention is based on the technical idea that a secondary particle in which contact between the primary particles is satisfactory (10 to 70%) is formed by using transition metals whose crystal lattice will hardly vary in volume in charge/discharge and by setting the voidage of the secondary particle to a predetermined value.

Japanese Patent Publication 2001-243951 (Matsumoto et al.) discloses a positive electrode active material for a non-aqueous electrolyte secondary battery, which is comprised of secondary particles, each of secondary particle being composed of fine primary particle of lithium cobalt oxide. At least a part of the fine

primary particles in a secondary particle are arranged in radiation toward outside from the center of the secondary particles. The secondary particles have many fine gaps among primary particles, in which the electrolyte can infiltrate.

The Matsumoto et al. publication does not describe the transition metal content as defined in the present invention. In addition, as the examiner has acknowledged, Matsumoto et al. does not expressly teach that the length in which the plural primary particles are linked on the section of the secondary particle is equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles.

That is, the Matsumoto et al. publication fails to suggest the technical idea that a secondary particle in which contact between the primary particles is satisfactory (10 to 70%) is formed by using transition metal whose crystal lattice will hardly vary in volume in charge/discharge.

The Shiozaki et al. publication discloses a positive electrode active material for a lithium secondary cell having a high energy density and excellent in charging/discharging cycle performance, and a lithium secondary cell having a high energy density and excellent in charging/discharging cycle performance are disclosed. A positive electrode active material for a lithium secondary cell is characterized in that the composition of the active material is $\text{Li}_x\text{Mn}_a\text{Ni}_b\text{Co}_c\text{O}_2$ (where a, b, and c are values of a point (a, b, c) on a side of or inside a quadrilateral ABCD having vertexes A(0.5, 0.5, 0), B(0.55, 0.45, 0), C(0.55, 0.15, 0.30), and D(0.15, 0.15, 0.7) on a ternary state diagram showing the relationship among a, b, and c, and satisfy the expressions $0.95 < x/(a+b+c) < 1.35$) and in that the active material contains a composite oxide having an $\alpha\text{-NaFeO}_2$ structure. The lithium secondary cell comprises this active material.

Even if the Shiozaki et al. publication discloses a fiber-shaped metal, clearly it does not describe that the length in which the plural primary particles are linked on the section of the secondary particle is equivalent to 10 to 70% of the length of the whole periphery on the section of the plural primary particles.

That is, the Shiozaki et al. publication also fails to suggest the technical idea that a secondary particle in which contact between the primary particles is satisfactory (10 to 70%) is formed by using transition metal whose crystal lattice will hardly vary in volume in charge/discharge.

As described above, nothing Matsumoto et al. nor Shiozaki et al. describes a basic aspect of the present invention. Thus, even if JP '951 and WO '881 are considered in connection with each other it would not have been possible to arrive at the finding that when transition metal in the composite oxide ($\text{Li}_a\text{Mn}_x\text{Ni}_y\text{Co}_z\text{O}_2$) in which the Ni content is below 50% ($0.35\% \leq 0.5$) is used for a positive electrode material, a crystal lattice will hardly vary in volume during charge/discharge, primary particles will hardly be distorted when contact between them is satisfactory (10 to 70%), and a cycle characteristic will be excellent.

That is, even if JP '951 and WO '881 are combined, it would not have been possible to associate the composition and voidage of a positive electrode material with the length in which the plural primary particles are linked on the section of the secondary particle relative to the length of the whole periphery on the section of the plural primary particles.

The Examiner cites JP '006 as disclosing a positive electrode material comprising a lithium composite oxide in the form of primary flocculated into secondary particles in which the percentage of voids in the secondary particles is 2-30% or less, preferably 10-20%. However, it is submitted JP '006 does not remedy the other deficiencies noted above with respect to Matsumoto et al. and Shiozaki et

al. Accordingly, it is submitted claims 14, 16 and 18 are patentable over the proposed combination of documents, at least for the reasons noted above.

In view of the foregoing amendments and remarks, entry of this amendment and favorable reconsideration and allowance of all of the claims now in the application are requested.

To the extent necessary, applicants petition for an extension of time under 37 CFR 1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to the deposit account of Antonelli, Terry, Stout & Kraus, LLP, Deposit Account No. 01-2135 (Case: 1021.43559X00), and please credit any excess fees to such deposit account.

Respectfully submitted,

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